Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

A PRE-TERTIARY NEPHELINE-BEARING ROCK.

WHILE engaged in a petrographical study of the glacial drift bowlders in the neighborhood of Columbus, Ohio, with a view to ascertaining their possible source, a bowlder of unusual interest was noted. It is related to types which have only recently been described in this country. The rarity and interest of the type and the hope of making possible its future identification with an occurrence found in place seems to justify a special description of this bowlder. Only a single specimen was found. This was about a foot and a half in diameter, with a surface weathering conspicuously rough and brown.

Macroscopical characters.— On the fresh fracture the rock shows a dark gray, compact, aphanitic groundmass, thickly studded with lath-shaped or, more rarely, tabular crystals of a triclinic feldspar. These phenocrysts have an average length of half an inch, but may be more than twice that length. They are white to colorless and translucent, with a pearly luster, and show the striations due to polysynthetic twinning. Upon the weathered surface of the rock they stand out in marked relief and are an opaque white, with a chalky texture.

Less conspicuous, but distributed in great abundance through the rock, are groups of broadly rectangular, or hexagonal, white or nearly colorless crystals. These crystals do not exceed two millimeters in diameter and are uniformly and clearly distinguished from the feldspar by their shape and size. They are not in marked relief on the weathered surface, but are conspicuous as small, squarish, chalky white spots.

A dark-colored, ferromagnesian constituent, presumably augite, is present less conspicuously, as a phenocryst. Magnetite can also be detected, and doubtfully olivine.

Microscopical characters.—The microscope shows the essential constituents of the rock to be plagioclase, nepheline, augite and hornblende. As accessory constituents, always present in some amount, are olivine biotite, apatite and magnetite. As secondary constituents are a zeolite, muscovite, kaolin, calcite and uralite. The rock is comparatively fresh and possesses a panidiomorphic holocrystalline structure. Secondary structures due to pressure are not manifest.

Plagioclase.—The feldspar is fresh, idiomorphic and polysynthetically twinned. The twinning lamellæ are indistinct and irregular. It is comparatively free from inclusions which, when present, are apatite, augite and hornblende crystals and microlites. Some of the feldspar was isolated and its specific gravity tested by the Thoulet solution. It proved to be 2.642 indicating a variety of the oligoclase-albite series. Feldspar of the second generation occurs in the groundmass, of which it constitutes the major part. It is broadly lath-shaped and does not show repeated twinning, but is, in many instances, twinned according to the Carlsbad law. Besides occurring in lath-shaped crystals it acts as a cementing material for the minerals of the groundmass. The presence of muscovite is conspicuous as an alteration product. This alteration product, the high alkali percentage of the groundmass and the optical properties, indicate that the feldspar of the groundmass belongs at the more acid end of the series, probably orthoclase in part.

Nepheline.—The groups of colorless, broadly prismatic or hexagonal crystals observed in the hand specimen prove to be nepheline. The hexagonal sections show the broad uniaxial cross and negative double-refraction of nepheline. The prismatic sections show parallel extinction, a weak double refraction, and two rectangular cleavages. The crystals contain as inclusions apatite and augite. The former is abundant throughout the sections in idiomorphic crystals, and is readily distinguished from the nepheline by its higher index of refraction. The nepheline is frequently quite fresh but sometimes shows alteration into a radiating zeolite which possesses the optical properties of natrolite. The alteration begins on the outer edge and the nepheline crystals are, in many instances, bordered with a narrow edge of radiating zeolite needles. In association with this alteration is an alteration to colorless, brilliantly polarizing muscovite. The nepheline also weathers into an irresolvable, granular, whitish, dimly polarizing substance which may be kaolin. Some of the powdered rock, from which was excluded all phenocrysts except nepheline, was tested for the alkalies. Three-tenths of one gram of this powder, of which about one-half was nepheline, showed an alkali content as follows: soda, 8.32 per cent.; potash, 7.08 per cent. A sample of the powdered nepheline, very nearly pure, gave soda, 7.70 per cent.; potash, 3.74 per cent. The presence of a potash feldspar, as an orthoclase, in the groundmass would account for the high potash percentage in the first sample.

Augite.—Augite occurs in unmistakable, idiomorphic crystals of a violet color. There is a manifest pleochroism. $\mathfrak{c}$ = violet. $\mathfrak{a}$ = green. The crystals are frequently bounded by the prismatic and pinacoidal planes, giving octagonal cross-sections. Twinning parallel to the orthopinacoid is present, and zonal structure is not uncommon. Inclusions of apatite and magnetite are abundant. More rarely are found inclusions of olivine. The peripheries of the crystals show a narrow border of alteration to a uralitic, or to a reddish brown, hornblende.

Hornblende.—This mineral occurs both as phenocrysts and as a constituent of the groundmass. In the former case it is a rich red brown, with marked pleochroism and absorption. $\mathfrak{c}$ = reddish brown. $\mathfrak{a}$ = yellowish green. Cross sections show the hornblende angle. The hornblende-phenocrysts are not so numerous nor so large as the augite-crystals.

In the groundmass the slender lath-shaped, frayed crystals of a pleocroic reddish brown or a green hornblende are a conspicuous feature. These, which are abundant, together with biotite, augite and magnetite, are distributed through a colorless feldspathic matrix and constitute the dark-colored constituents of the groundmass. An alkali feldspar, a secondary muscovite, and minute specks of calcite constitute the colorless portion of the groundmass. The presence of calcium carbonate is attested both by the brightly polarizing specks and by the effervescence of the powdered rock. Apatite is particularly abundant in fine crystals and may be included in any of the other constituents.

Olivine.—Olivine occurs characteristically in small crystals and rounded grains of the first generation. The high index of refraction, high double-refraction, parallel extinction, and dispersion of the still unaltered grains are all characteristic of olivine. It is, however, an inconspicuous and infrequent constituent of the rock, and is much altered to serpentine, hematite and magnetite.

In the order of their abundance the primary constituents should be named as follows: feldspar, nepheline, augite, hornblende and olivine. Both the feldspar and nepheline occur in greater abundance than any one of the ferromagnesian constituents and together constitute perhaps two-thirds of the rock mass. The structure is not so characteristically that of either a dyke or surface rock as to make it possible to determine the exact position occupied by the rock when cooling.

The character of the crystallization indicates the comparatively slow cooling of a "*hypabyssische*" rock. This crystallization may have taken place along the edge of a deep-seated magma, throughout an intrusive magma or in the central part of a surface flow.

A determination of the exact species of this rock from the study of a single bowlder must be more or less inaccurate and hence undesirable. Since a generic term only, can be affixed to the rock, the choice lies between the nepheline-syenite-porphyry and the theralite-porphyry groups. The highly alkaline character of the feldspars which constitute so large a proportion of the rockmass relates the rock perhaps more closely to the nepheline-syenite-porphyry group than to the theralite-porphyries. Like the nepheline-syenite-porphyries described by Brögger, it contains accessory olivine,[1] and comparatively abundant augite and hornblende.[1] A further justification of placing in the syenite group a rock showing so large an amount of the ferro-magnesian constituents is found in the new group of rocks recently described by Weed and Pirsson from the Highwood Mountains[2] and Yogo Peak,[3] Montana, in the lamprophyres of Gallatin, Jefferson and Madison counties, Montana, described by Merrill,[4] and in the banakites of the Yellowstone National Park and vicinity described by Iddings.[5]

---

[1] W. C. Brögger, Die Mineralien der Syenit-pegmatit-gänge der südnorwegischen Augit- und Nephelinsyenit. Groth's Zeitsch. für Krys. und Nien., Vol. XVI., pp. 32, 39.

Here we have a series of rocks with orthoclastic groundmasses combined with variable proportions of the ferro-magnesian silicates (augite, hornblende, biotite and olivine) with a wide silica range, all related to the syenite group.

Age.—That the drift material in the neighborhood of Columbus has its source from the north shore of Lake Huron in Canada and from northern Michigan was sufficiently indicated by petrographic study. Distinct types from the bowlders were matched both in the hand specimen and under the microscope to specimens taken from ledges in Canada and Michigan. While such matching was not valuable with the monotonous granites, gneisses and quartzites which constitute the great bulk of the bowlder material, a sufficient number of pronounced types were harmonized to establish both the age and the general source of the bowlder material.

Representatives of the Archæan, Algonkian, Cambrian and Lower Silurian formations are found among the bowlders. All the igneous material is undoubtedly pre-Cambrian or Cambrian. The presence of this member of the nepheline-syenite-porphyry group cannot be explained except on the supposition that it was, like the material among which it was found, brought to Ohio from a northern source, and is, like all the igneous drift material, of Cambrian or, more probably, pre-Cambrian age. A nepheline-syenite has been described by Dr. Adams[1] from southern Canada. A type related to the nepheline-basanite, Dr. Adams says, is known in Canada, in the vicinity of Montreal, where it forms dikes connected with the intrusive stock of Mt. Royal. There is no reason why a similar rock should not occur west of Montreal, and it may yet be described. It is impossible to say at present whether this nepheline-bearing rock is in any way related to these formations or is related as a dyke to some yet undescribed nepheline-syenite area on the north shore of Lake Huron. In any case it is a pre-Tertiary dike or surface, volcanic, resembling the modern type and thus affording another instance of the essential similarity of ancient and modern rock types.

---

[1] W. C. BRÖGGER, Die Eruptivgesteine des Kristianiagebietes. I. Die Gesteine der Grorudit-Tinguait-Serie. Kristiania, 1894.

[2] Highwood Mountains of Montana, Bull. Geol. Soc. Amer., Vol. VI., p. 414.

[3] Igneous Rocks of Yogo Peak, Amer. Jour. Sci., Vol. L., No. 300, Dec. 1895, pp. 467–479.

[4] GEORGE P. MERRILL, Notes on Some Eruptive Rocks from Gallatin, Jefferson and Madison counties, Montana. Proc. U. S. Nat. Museum., Vol. XVII., pp. 665.

[5] J. P. IDDINGS, Absarokite-Shoshonite-Banakite Series, THE JOURNAL OF GEOLOGY, Vol. III., No. 8, Nov.–Dec. 1895, pp. 935–939.

F. BASCOM.

BRYN MAWR COLLEGE.

---

[1] F. D. ADAMS, on the occurrence of a large area of nepheline-syenite in the township of Dungannon, Ontario, Am. Jour. Sci., 198, pp. 10–18.